

On the taxonomic system of Eurasian Oedipodidae (Orthoptera : Caelifera)

YIN Xiang-Chu^{1,3*}, WANG Wen-Qiang^{1,2}

(1. College of Life Sciences, Hebei University, Baoding, Hebei 071002, China;

2. College of Life Sciences, Yan'an University, Yan'an, Shaanxi 716000, China;

3. College of Plant Protection, Shandong Agricultural University, Tai'an, Shandong 271018, China)

Abstract: This paper provides a new taxonomic system for the Eurasian Oedipodidae, in which the 69 known genera are divided into 7 subfamilies including 3 new subfamilies: Locustinae, Oedipodinae, Heteropterninae subfam. n., Bryodeminae, Bryodemellinae, Oedipodacrinae subfam. n., and Rashidinae subfam. n.

Key words: Oedipodidae; taxonomic system; new subfamily; Eurasia

Oedipodids (band-winged grasshoppers) are a very important group of grasshoppers and distributed in all zoogeographical regions. So far, 124 genera have been described worldwide in this group (Yin *et al.*, 1996; Otte and Naskrecki, 2004). Among them, some species are the world famous pests to agriculture and grazing, e. g. *Locusta migratoria* (Linnaeus, 1758), *Oedaleus decorus* (Germar, 1826), etc. So, the study on the taxonomy of this group is rather important.

Since the group was first established as a family by Walker (1870), it was treated as family Oedipodidae (Yin, 1982, 1984; Zheng, 1985, 1993; Zheng and Xia, 1998), subfamily Oedipodinae (Kirby, 1914; Willemse, 1932; Bei-Bienko and Mishchenko, 1951, 1963; Chopard, 1951; Xia, 1958; Dirsh, 1975; Otte, 1984; Willemse, 1984, 1985; Otte and Naskrecki, 2004) or tribe Oedipodini (Dirsh, 1961; Harz, 1975) depending on different taxonomic systems. Attempts to develop a taxonomic system for this group had been made by some taxonomists. For example, Otte (1984) divided Oedipodids of the North American into seven genus groups; Otte and Naskrecki (2004) divided Oedipodinae (= Oedipodidae in this paper) worldwide into fifteen tribes. The Chinese taxonomists (e. g., Yin, 1982, 1984; Zheng, 1993; Zheng and Xia, 1998; etc.) usually divided Oedipodidae into four subfamilies. But, a taxonomic system for the Eurasian Oedipodidae is still absent by now.

In this paper, the family Oedipodidae with sixty-nine known genera from Eurasia is divided into seven subfamilies, i. e. Locustinae, Oedipodinae, Heteropterninae subfam. n., Bryodeminae, Bryodemellinae,

Oedipodacrinae subfam. n. and Rashidinae subfam. n.; three of them are new.

Main Characters Used in Classification

Elytra and hindwings developed, able to sound and fly (Figs. 1–5) or undeveloped, scale-like, lateral, unable to sound and fly (Figs. 6–7). Medial area of elytra with (Figs. 1–4) or without (Fig. 5) intercalary vein. Intercalary vein serrated (Fig. 1:a) or smooth. Elytra with (Fig. 3:f) or without (Figs. 1–2, 4–5) regular parallel cross veins before the intercalary vein of the medial area. Main longitudinal veins of hindwings normal (Figs. 1–3) or obviously thickened (Figs. 4–5), with (Fig. 4:k) or without finely serrations in ventral face. Upper carina of hind femora smooth (Fig. 2:e) or serrated (Fig. 1:b). Tympanum present (Fig. 1:c) or absent.

Oedipodidae

Body from large to medium and small sized, often robust. Frons perpendicular in profile, some times inclined backward. Vertex short and broad, flat or slightly concave dorsally, oblique forward or horizontal, fastigial furrow absent. Lateral foveola triangular, irregular round or trapeziform, some times indistinct, even absent. Antennae filiform. Dorsum of pronotum saddle shaped, tectiform, crested, or flat. Prosternum flat or appreciably swelled between bases of fore legs, without prosternal process. Tegmina and wings developed, some times abbreviated in female, or degenerated as squama. Tegmina with serrated intercalary vein in medial area or intercalary vein

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作者简介: 印象初, 男, 1934年生, 中国科学院院士, 博士生导师, 主要从事蝗虫分类学研究, E-mails: yxch@sdau.edu.cn

* 通讯作者 Author for correspondence

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Figs. 1 – 7 Main characters used in classification of Eurasian Oedipodidae

- 1. *Locusta migratoria migratoria* (Linnaeus , 1758) , ♂ , (a) Partial enlarged for intercalary vein , showing sound teeth on the intercalary vein ; (b) Partial enlarged for the upper carina of hind femur in lateral view , showing serrations ; (c) Tympanal organ ;
- 2. *Oedipoda caerulescens* (Linnaeus , 1758) , ♂ , (d) Partial enlarged for medial area , showing developed intercalary vein ; (e) Partial enlarged for the upper carina of hind femur in lateral view , showing serrations absent on it ;
- 3. *Heteropternis respondens* (Walker , 1859) , ♂ , (f) Partial enlarged for medial area , showing intercalary vein and regular parallel cross veins before the intercalary vein ; (g) Partial enlarged for parallel cross veins , showing sound teeth on them ; (h) Enlarged for terminal part of hind tibia , showing lower and upper spurs on the inner side not equal to each other in length ;
- 4. *Angaracris barabensis* (Pallas , 1773) , ♂ , (i) Partial enlarged for medial area , showing strongly developed intercalary vein ; (j) Enlarged for basal part of hind tibia , showing regular parallel transversal wrinkles ; (k) Partial enlarged for ventral side of thickened longitudinal veins , showing fine serrations on them ;
- 5. *Bryodemella holdereri* (Krauss , 1901) , ♂ , (l) Partial enlarged for medial area , showing intercalary vein absent ; (m) Partial enlarged for apical half of hind femur in lateral view , showing finely serrated on the upper external carina ; (n) Partial enlarged for the upper external carina , showing fine serrations ;
- 6. *Oedipodacris aberrans* Willemse , 1932 , ♀ , elytra and hindwings degenerated , tympanum present (from Willemse , 1932) ;
- 7. *Rashidia perplexa* Uvarov , 1933 , ♀ , elytra and hindwings degenerated , tympanum absent (from Uvarov , 1933) .

indistinct even absent in few species. Wings often with black band , some times transparent and colorless , and main longitudinal veins obviously thickened in some groups. Hind femora with pinnate carinae on outer side , without sound teeth line on inner side , upper basal lobe longer than the lower one , median keel of upper side smooth or serrated , apex of lower kneelobe rounded or angular. Hind tibiae without outer apical spine. Empodium between claws small. Tympanum organ developed , or absent in few species. Male circus simple , conical or cylindrical ; supra-anal plate angular ; subgenital plate short conical or subconical ; epiphallus bridge shaped , with ancorae and lophi. Ovipositor short , with curved valves.

Key to subfamilies of Oedipodidae from Eurasia

- 1 Elytra and hindwings developed , able to sound and fly. Tympanum developed 2
Elytra and hindwings undeveloped , scale-like , lateral , unable to sound and fly. Tympanum undeveloped or absent 6
- 2 Upper carina of hind femora smooth , not serrated 3
Upper carina of hind femora serrated , rubbing with hind wings to produce sound when flying **Locustinae**
- 3 Main longitudinal veins of hindwings normal , not obviously thickened ; if thickened , then not serrated ventrally 4
Main longitudinal veins of hindwings obviously thickened ; finely serrated ventrally , especially in male 5
- 4 Elytra without regular parallel cross veins before the intercalary vein of the medial area **Oedipodinae**
Elytra with regular parallel cross veins before the intercalary vein of the medial area , projecting above the surface , serrated. This part of the elytron is an efficient stridulatory organ **Heteropterninae , subfam. n.**
- 5 Elytra with serrated intercalary vein in medial area , as a part of stridulating apparatus **Bryodeminae**
Elytra without intercalary vein in medial area ; or intercalary vein weak , not serrated **Bryodemallinae**
- 6 Tympanum present **Oedipodacrinae , subfam. n.**
Tympanum absent **Rashidinae , subfam. n.**

Locustinae

Body medium to large sized. Elytra and hindwings strongly developed , able to sound and fly very well. Elytra with obviously serrated intercalary vein in medial area , but without regular parallel cross veins before the intercalary vein. Main longitudinal veins of hindwings normal , not thickened. Upper carina of hind femora serrated. Tympanum developed.

Type genus : *Locusta* Linnaeus , 1758 (Fig. 1).

Seven genera of this subfamily are distributed in Eurasia : *Chloebora* Saussure , 1884 ; *Dittopternis* Saussure , 1884 ; *Gastrimargus* Saussure , 1884 ; *Locusta* Linnaeus , 1758 ; *Pternoscirta* Saussure , 1884 ; *Pynodictya* Stål , 1873 and *Scintharista* Saussure , 1884.

Distribution : over the Europe , Asia , Africa , Oceania and the adjacent areas.

Oedipodinae

Body small , medium or large sized. Elytra and hindwings fully developed , able to sound and fly.

Elytra with serrated intercalary vein in medial area , without regular parallel cross veins before the intercalary vein. Main longitudinal veins of hindwings normal , not thickened. Upper carina of hind femora smooth , not serrated. Tympanum developed.

Type genus : *Oedipoda* Latreille , 1829 (Fig. 2).

Forty-eight genera of this subfamily are distributed in Eurasia : *Acrotylus* Fieber , 1853 ; *Aiolopus* Fieber , 1853 (= *Epacromia* Fischer-Waldheim , 1853 ; *Aeolopus* Kirby , 1910 ; *Aeoloptilus* Bei-Bienko , 1966) ; *Asphingoderus* Bei-Bienko , 1950 ; *Aurilobulus* Yin , 1979 ; *Brunnerella* Saussure , 1888 ; *Celes* Saussure , 1884 ; *Chifanicus* Benediktov , 2001 ; *Chondronotulus* Uvarov , 1956 ; *Cophotylus* Krauss , 1902 (= *Somalella* Dirsh , 1949) ; *Cyanicaudata* Yin , 1979 ; *Epacromius* Uvarov , 1942 ; *Eremoscopus* Bei-Bienko , 1951 ; *Eusphingoderus* Bei-Bienko , 1950 ; *Eusphingonotus* Bei-Bienko , 1950 ; *Flatovortex* Zheng , 1981 ; *Grammoscapha* Uvarov , 1942 ; *Heliopteryx* Uvarov , 1914 ; *Helioscirtus* Saussure , 1884 (= *Vosseleria* Uvarovc , 1923) ; *Hilethera* Uvarov , 1923 ; *Hyalorrhapis* Saussure , 1884 ; *Jacobsiella* Harz , 1975 ; *Kinshaties* Zheng , 1977 ; *Leptopternis* Saussure , 1884 ; *Longipternis* Yin , 1984 ; *Mecistopteryx* Saussure , 1888 ; *Mioscirtus* Saussure , 1888 (= *Microscirtus* Saussure , 1888 ; *Thiopteris* Houlbert , 1927) ; *Morphacris* Walker , 1870 (= *Cosmorhyssa* Stål , 1873) ; *Neosphingonotus* Benediktov , 1998 ; *Ochyracris* Zheng , 1991 ; *Oedaleus* Fieber , 1853 ; *Oedipoda* Serville , 1831 (= *Eusternum* Wesmaël , 1838 ; *Aedipoda* Le Guillou , 1841 ; *Ctyophippus* Fieber , 1852 ; *Ctyophippus* Bolivar , 1876) ; *Paracinema* Fischer , 1853 ; *Parapleurodes* Ramme , 1941 ; *Parapleurus* Fischer , 1853 ; *Phaeonotus* Popov , 1951 ; *Platypygius* Uvarov , 1942 ; *Pseudocoles* Bolivar , 1899 (= *Grusia* Harz , 1978) ; *Psophus* Fieber , 1853 ; *Ptetica* Saussure , 1884 ; *Pusana* Uvarov , 1940 (= *Pusa* Uvarov , 1921) ; *Pyrgodera* Fischer-Waldheim , 1846 ; *Quadriverticis* Zheng , 1999 ; *Sphingoderus* Bei-Bienko , 1950 ; *Sphingonotus* Fieber , 1852 (= *Pseudosphingonotus* Shumakov , 1963) ; *Thalpomena* Saussure , 1884 ; *Tibetacris* Chen , 1964 ; *Trilophidia* Stål , 1873 and *Vosseleriana* Uvarov , 1924.

Distribution : over the Europe , Asia , Africa , Oceania , America and the adjacent areas.

Heterapterninae , subfam. n.

Body medium sized. Frons perpendicular or sloping backward in profile. Vertex without fastigial furrow in the middle of anterior border. Antennae filiform. Lateral foveolae triangular , not much distinct. Prosternum appreciably swelled. Elytra and hindwings fully developed , able to sound and fly. Elytra with developed intercalary vein in medial area and regular parallel cross veins before the intercalary vein , both

intercalary vein and the parallel cross veins serrated. Main longitudinal veins of hindwings normal, not thickened. Hind femur with pinnate carinae on outer side, upper basal lobe longer than the lower one, upper carina smooth, not serrated. Lower spur on inner side of hind tibiae evidently longer than upper one, apex obviously curved hook-like, some times the lower spur not evidently longer. Tympanum developed. Krauss organ absent.

Type genus : *Heteropternis* Stål, 1873 (Fig. 3).

The new subfamily is allied to Oedipodinae, but the trait of that the elytra with regular parallel cross veins before the intercalary vein of medial area, and the parallel cross veins project above the surface, serrated, which is an efficient stridulatory organ excepting for the intercalary vein, obviously differ from Oedipodinae. So, the new subfamily Heterapterninae has been established.

Three genera of this new subfamily are distributed in Eurasia : *Compsorhipis* Saussure, 1889 ; *Heteropternis* Stål, 1873 and *Mecostethus* Fieber, 1852.

Distribution : Europe, Asia, Africa and Oceania.

Bryodeminae

Elytra and hindwings developed, able to sound and fly, some times abbreviated in female. Elytra with serrated intercalary vein in medial area, without regular parallel cross veins before the intercalary vein. Main longitudinal veins of hindwings obviously thickened, finely serrated ventrally. Upper carina of hind femora smooth, not serrated; its upper external carina not serrated in apical half. Lower knee lobes of inner side of hind femora nearly upright, not tilted inward. Dorsal swollen part of base of hind tibia smooth, or with parallel transverse wrinkles or irregular wrinkles. Tympanum developed.

Type genus : *Bryodema* Fieber, 1853

Six genera of this subfamily are known in Eurasia : *Andrea* Mishchenko, 1989 ; *Angaracris* Bei-Bienko, 1930 (Fig. 4); *Angaracrisoides* Gong et Zheng, 2003 ; *Bryodema* Fieber, 1853 ; *Bryodemacris* Benediktov, 1998 and *Uvaroviola* Bei-Bienko, 1930.

Distribution : Russia, Mongolia, Kazakstan, China and Korea.

Bryodemellinae

Elytra and hindwings developed, able to sound and fly, some times abbreviated in female. Elytra without or with weak and not serrated intercalary vein in medial area, without regular parallel cross veins before the intercalary vein. Main longitudinal veins of hindwings obviously thickened, finely serrated ventrally. Upper carina of hind femora smooth, not serrated; its upper external carina finely serrated in

apical half, stridulating with thickened longitudinal veins of hindwings. Lower knee lobes of inner side of hind femora tilted inward. Tympanum developed.

Type genus : *Bryodemella* Yin, 1982 (Fig. 5).

Three genera of this subfamily are found in Eurasia : *Bryodemella* Yin, 1982 ; *Fitzgeraldia* Uvarov, 1952 and *Jinabia* Uvarov, 1952.

Distribution : Central and Western Europe : Germany, Denmark, Scandinavia, Finland, the Bavarian Alps ; European part of the Russia ; Arabia, Transbaikali, Kazakhstan, Mongolia and China (western and northern areas).

Oedipodacrinae, subfam. n.

Body medium sized. Head about as long as pronotum. Frons slightly reclinate, frontal ridge indistinct. Vertex sloping, formed a round angle with frontal ridge. Temporal foveolae absent. Antennae filiform. Eyes globular, prominent sideways. Pronotum cylindrical, three transverse sulci distinct on the disc, metazona far longer than prozona; medial keel indistinct, lateral keels absent. Elytra and hindwings undeveloped, scale-like, lateral, unable to sound and fly. Tympanum undeveloped. Prosternum smooth, without tubercle. Mesosternal lobes separated widely. Metasternal lobes contiguous. Upper carina of hind femora sub-serrated. Hind tibiae without outer apical spine. Hind tarsi reaching beyond the middle of hind tibia. Valves of ovipositor in female narrow, margins smooth.

Type genus : *Oedipodacris* Willense, 1932 (Fig. 6).

The new subfamily is close to Locustinae because of hind femora sub-serrated on upper carina. But, its character of that elytra and hindwings degenerated, scale-like, lateral, unable to sound and fly, differed from that of Locustinae essentially. This group with the sound organ degenerated and the hearing organ undeveloped might be a more evolutionary clade differentiated from Locustinae.

Only one genus of the subfamily is found in Eurasia : *Oedipodacris* Willense, 1932.

Distribution : Assam of India.

Rashidinae, subfam. n.

Body small in size, strongly coarse, with tubercles and rugosities. Frons vertical, frontal ridge wide, sulcate throughout. Vertex sloping forward, without fastigial furrow, but with two deeply concave and strongly transverse foveolae, all margins raised. Antennae filiform. Lateral foveolae small, distinct. Pronotum very coarse, median carina distinct, deeply cut by three transverse sulci; posterior margin wavy. Elytra and hindwings undeveloped, minute, scale-like, lateral, unable to sound and fly. Hind femora thick,

with tubercles on the upper external area ,not serrated on upper carina. Hind tibiae thick ,without outer apical spine. Empodium between tarsal claws minute. Abdomen with evident tubercles and median keel. Tympanum absent.

Type genus : *Rashidia* Uvarov , 1933 (Fig. 7).

This subfamily distinctly differs from all known subfamilies of Oedipodidae by the tympanum absent and elytra obviously degenerated. Thus , the new subfamily is established. Owing to both their sound and hearing organs degenerated even to absent , this new subfamily should be a most evolutionary group of Oedipodidae.

Only one genus of this new subfamily is known in Eurasia : *Rashidia* Uvarov , 1933.

Distribution : South Arabian Desert.

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欧亚大陆斑翅蝗科分类系统

(直翅目 : 蝗亚目)

印象初^{1 3 *} , 王文强^{1 2}

(1. 河北大学生命科学学院 , 河北保定 071002 ; 2. 延安大学生命科学学院 , 陕西延安 716000 ;
3. 山东农业大学植物保护学院 , 山东泰安 271018)

摘要 : 对分布在欧亚大陆的斑翅蝗科 Oedipodidae 昆虫进行了亚科分类研究 , 将已知的 69 个属分为 7 个亚科 : 飞蝗亚科 Locustinae , 斑翅蝗亚科 Oedipodinae , 异距蝗亚科 Heteropterninae subfam. n. , 痼蝗亚科 Bryodeminae , 异痼蝗亚科 Bryodemellinae , 哑斑翅蝗亚科 Oedipodacrinae subfam. n. 和聋斑翅蝗亚科 Rashidinae subfam. n. , 其中包括 3 个新亚科。建立了欧亚大陆斑翅蝗科新的亚科分类系统。

关键词 : 斑翅蝗科 ; 分类系统 ; 新亚科 ; 欧亚大陆

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